Geochemical effects of a hill reservoir leakage above downstream alluvial aquifer (watershed of El Gouazine, Central Tunisia)

J.P. Montoroi [1], O. Grünberger [1], S. Nasri[2]

[1]IRD, 32 Avenue H. Varagnat, 93143 Bondy, France (montoroi@bondy.ird.fr, grunberger@msem.univ-montp2.fr)
[2]INRGREF, Rue Hédi Karray, BP 10, 2080 Ariana, Tunisie (nasri.slah@iresa.agrinet.tn)

El Gouazine reservoir (35°55'N, 9°45'E) is one of the five Tunisian experimental sites monitored in the European Union Hydromed program for the development of Mediterranean hill reservoirs (Albergel et Rejeb, 1997).
Analyses of hydrological balance, piezometric fluctuations and isotopic contents (^{18}O et ^{2}H) in downstream wells allow the authors to quantify the leakage of the reservoir to the alluvial aquifer. Underground outflow ranges from 170 m^3j^{-1} to 300 m^3j^{-1}, depending on the water level of the reservoir. In this preliminary phase, the isotopic change of the upstream and downstream groundwaters has been interpreted as being the result of the dilution effect of the groundwater by the reservoir water flow (Grünberger et al, 1999; Montoroi et Grünberger, 1999 ; Montoroi et al, 1998, 2001). The present paper identifies the chemistry of waters and solid phases (rock, soils, sediments...) which can explain the relationships between reservoir water and groundwater.
In May 1998, water sampling (surface water, groundwater and reservoir water) was done within and beyond the 18 km^2 El Gouazine catchment located in Central Tunisia. As well as the chemical water analyses (major and trace elements), the main pedological and geological formations of the watershed, including lacustrine deposits and alluvial materials, were analyzed using X-ray diffraction and chemical analyses (major and trace elements).
On the basis of major ion concentrations, three groundwater types (calcium-bicarbonate, sodium-chloride, calcium sulphate) are distinguished in relation with the bedrock (limestone, marl, gypsiferous marl, gypsiferous argillite, sandstone). Ba, Cr, Mn and Ti are the most reliable trace-elements characterizing the bedrock-groundwater interactions.
The abundant carbonate rock in the basin, and the rapid weathering rate of carbonate minerals suggests that dissolution of carbonate minerals will add significant amounts of Ca and Mg to the reservoir. In argillite and marl, the dissolution of gypsum is the source of sulphate and additional calcium in groundwaters. The composition of the reservoir water suggests a strong influence fromis gypsum weathering. Na is in excess for all the downstream wells, and one potential source of excess Na is weathering of feldspar as found in a sandstone outcrop.
In the dry season, the alluvial aquifer is influenced by other distinct aquifers intersected by the riverbed (Figure 1). The alluvial aquifer is supplied by shallow groundwater stored in limestone aquifers leading to a strong decrease of electrical conductivity. Due to the high porosity of the limestone, these aquifers can accumulate a high water content and rapidly recharge or discharge. The reservoir also tends to decrease the electrical conductivity of the groundwater. In contrast, in alluvial groundwater flowing through less permeable argilleous materials which contain variable amounts of easily soluble minerals such as gypsum, the concentration of dissolved salts is increased.
In the downstream part of the reservoir, the influence of the dam leakage through the reservoir deposits, and the combined effects of the dilution by surface water and the contact with alluvial material is described and discussed.

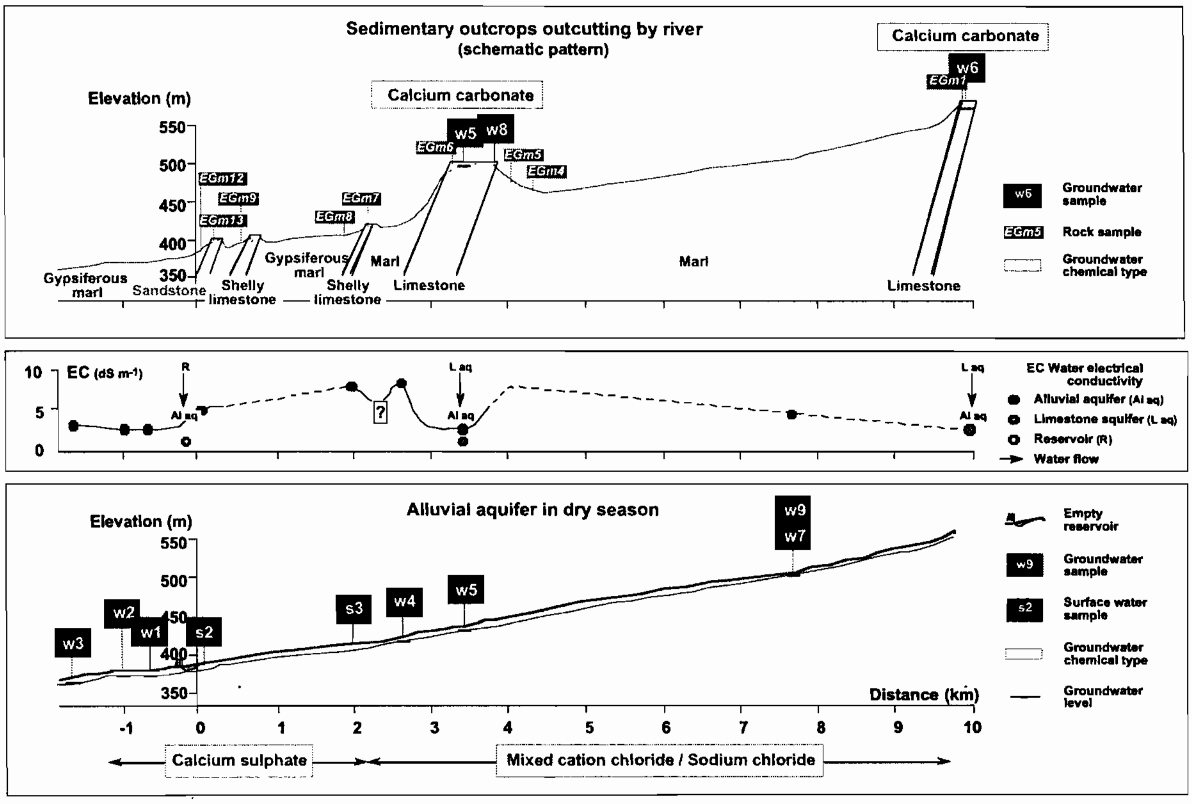

Figure 1. General hydrogeological features of the basin and electrical conductivity variation in relation to watershed geology.

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